

**Claims**

1. An apparatus for the application of a composition curable by irradiation to a fastener,

5 comprising:

- (i) a conveyor for conveying fasteners to an application station;
- (ii) an application station comprising an applicator from which the composition is dispensed, the conveyor for rotating at least part of the fasteners past the applicator for application of composition to the fasteners;
- 10 (iii) a conveyor for conveying the fasteners to an irradiation station and arranged to rotate the fasteners for irradiation thereof; and
- (iv) an irradiation station for curing the composition applied to each fastener.

2. An apparatus according to claim 1 wherein a first conveyor is provided for conveying fasteners to the application station, and a second conveyor is provided for  
15 conveying the fasteners to an irradiation station.

3. An apparatus according to claim 1 or claim 2 wherein the composition is an at least two stage curable composition;

the curable composition having a first cure stage which is activatable by irradiation, and a second cure stage which is curable to secure the fastener in a  
20 fastening position.

4. An apparatus according to claim 2 or claim 3 further comprising a fastener feeder for feeding fasteners one by one to the first conveyor.

5. An apparatus according to any one of claims 2 to 4 wherein the first conveyor extends through the application station.

25 6. An apparatus according to any preceding claim wherein the applicator is a coating block.

7. An apparatus according to any preceding claim wherein at least one dimension of the applicator may be altered.

8. An apparatus according to any preceding claim further comprising temperature  
30 control means for regulating the temperature of the fasteners prior to application of composition thereto.

9. An apparatus according to claim 8 wherein the temperature control means is an inline air blower.
10. An apparatus according to any one of claims 2 to 9 wherein the first conveyor is arranged for conveying the fasteners in a configuration each spaced apart from the next.
- 5 11. An apparatus according to any one of claims 2 to 10 wherein the second conveyor is arranged for conveying the fasteners in a configuration each spaced apart from the next.
12. An apparatus according to any one of claims 2 to 11 wherein the apparatus further comprises a transfer mechanism for transferring the fasteners to the second conveyor.
- 10 13. An apparatus according to claim 12 wherein the transfer mechanism is a conveyor.
14. An apparatus according to any one of claims 2 to 13 wherein the fasteners are conveyed by the first and/or second conveyor so that they are substantially horizontal.
- 15 15. An apparatus according to any one of claims 2 to 14 wherein the apparatus further comprises a rail for supporting the fasteners at least while the fastener is being conveyed by the first conveyor.
16. An apparatus according to any one of claims 2 to 15 wherein the apparatus comprises a rail for supporting the fasteners while being conveyed by the second conveyor.
- 20 17. An apparatus according to any one of claims 2 to 16 wherein the first and/or second conveyor comprises an endless belt which grips the fasteners between the belt and the rail so that movement of the belt moves the bolts along the rail.
18. An apparatus according to any preceding claim wherein two spaced apart rails are provided to support the fastener at least two positions thereon during conveying of the
- 25 fasteners.
19. An apparatus according to any one of claims 16 to 18 wherein the rail or rails for supporting the fasteners are adjustable so that different sizes of fasteners may be accommodated by the apparatus.

20. An apparatus according to any preceding claim wherein the application station comprises a supply system for supplying curable composition to the applicator.

21. An apparatus according to any preceding claim wherein the applicator has one or more apertures defined therein so that composition may be provided through the apertures to a surface on the applicator from an underside thereof.

22. An apparatus according to any preceding claim wherein temperature control means are provided on the applicator.

23. An apparatus according to any one of claims 2 to 22 wherein the first and/or second conveyor comprises an endless belt of material.

24. An apparatus according to claim 20 wherein said belt of material comprises resiliently deformable material.

25. An apparatus according to any preceding claim wherein the irradiation station comprises a UV light source for irradiating applied composition with UV light.

26. An apparatus according to claim 25 wherein the UV light source is a high intensity lamp, typically having an output of  $120\text{W}/\text{cm}^2$ .

27. An apparatus according to any preceding claim wherein the irradiation station comprises a focused radiation source.

28. An apparatus according to claim 27 wherein the irradiation station comprises a radiation source housed in a enclosure which focuses the radiation through an aperture therein.

29. An apparatus according to claim 28 wherein the aperture is arranged to focus a band of radiation onto the part of the fastener for receiving applied composition.

30. An apparatus substantially as described herein with reference to and/or as illustrated in the accompanying drawings.

31. A feed supply system for supplying a composition to the application station of an apparatus for the application of a composition curable by irradiation to a fastener comprising:

- (i) a volumetric supply pump for taking product from a product supply and supplying the composition to the application station in a volumetrically controlled fashion; and
- (ii) a control for controlling the supply rate of the pump.

5 32. A feed supply system according to claim 31 wherein the volumetric supply pump is an eccentric rotor pump.

33. An apparatus according to any one of claims 1 to 30 further comprising a feed supply system according to claim 31 or 32.

34. A curable composition suitable for use in threadlocking applications comprising:

- 10 (a) a (meth)acrylate functional monomer;
- (b) a (meth)acrylate functional oligomer;
- (c) a photoinitiator;
- (d) a thickener;
- (e) an amine;
- 15 (f) an encapsulated epoxy resin; and
- (g) optionally, an acrylamide.

35. A curable composition for application to a threaded article, comprising a dispersion of:

(i) components of a first cure mechanism comprising:

- 20 (a) a (meth)acrylate functional monomer component;
- (b) a (meth)acrylate functional oligomer component; and
- (c) a photoinitiator component;

(ii) components of a second cure mechanism comprising:

- (e) an amine component; and
- 25 (f) an encapsulated epoxy resin component; and
- (g) optionally, an acrylamide; together with

(iii) a thickener component suitable to impart sufficient viscosity to the uncured composition to maintain the dispersion of the other components in the composition; wherein the photoinitiator component is suitable upon irradiation of the composition to  
30 achieve a first cure through the depth of the composition applied to a threaded article so

that a binder matrix is formed with the components of the second cure mechanism dispersed through the matrix.

36. A curable composition according to claim 34 or 35 wherein component (a) comprises an acrylate monomer.

5 37. A curable composition according to any one of claims 34 to 36 wherein component (a) comprises mono-, di- or tri-acrylate.

38. A curable composition according to any one of claims 34 to 37 wherein component (a) comprises a combination of acrylate functional monomers.

10 39. A curable composition according to any one of claims 34 to 38 wherein: component (a) comprises a combination of mono- and di- functional acrylate monomers.

40. A curable composition according to any one of claims 34 to 39 wherein component (b) comprises an acrylate oligomer.

41. A curable composition according to any one of claims 34 to 40 wherein component (b) comprises epoxy acrylate.

15 42. A curable composition according to any one of claims 34 to 41 wherein component (b) comprises urethane acrylate.

43. A curable composition according to claim 42 wherein component (b) comprises a combination of epoxy acrylate and urethane acrylate.

20 44. A curable composition according to any one of claims 34 to 43 wherein component (c) comprises a component which enhances depth of cure.

45. A curable composition according to any one of claims 34 to 44 wherein component (c) comprises a component which enhances surface cure.

25 46. A curable composition according to any one of claims 34 to 45 wherein component (c) comprises a combination of a component which enhances depth of cure and a component which enhances surface cure.

47. A curable composition according to any one of claims 34 to 46 wherein component (c) comprises a phosphine oxide or a hydroxy ketone.

48. A curable composition according to any one of claims 34 to 47 wherein component (d) comprises an organic thickener.

30 49. A curable composition according to any one of claims 34 to 48 wherein component (d) comprises an inorganic thickener.

50. A curable composition according to any one of claims 34 to 49 wherein component (d) comprises a combination of an organic and an inorganic thickener.
51. A curable composition according to any one of claims 34 to 50 wherein component (e) comprises a tertiary amine.
- 5 52. A curable composition according to any one of claims 34 to 51 wherein component (e) comprises a hindered tertiary amine.
53. A curable composition according to any one of claims 34 to 52 wherein component (e) comprises a hindered aromatic tertiary amines.
54. A curable composition according to any one of claims 34 to 53 wherein  
10 component (f) comprises a microencapsulated monofunctional epoxy resin.
55. A curable composition according to any one of claims 34 to 54 wherein component wherein component (f) comprises a microencapsulated multifunctional epoxy resin.
56. A curable composition according to any one of claims 34 to 55 wherein the mean  
15 diameters of microcapsules in which component (f) is encapsulated is in the range of about 100 $\mu$ m to about 140 $\mu$ m.
57. A curable composition according to any one of claims 34 to 56 wherein the composition further comprises a plasticiser.
58. A curable composition according to claim 56 wherein the plasticiser is a  
20 polymeric one.
59. A curable composition according to any one of claims 34 to 58 wherein the composition further comprising a pigment component for imparting a colour to the composition.
60. A curable composition according to claim 58 wherein the pigment component is a  
25 metal complex.
61. A curable composition according to claim 59 wherein the pigment component is an Fe or Co complex.
62. A composition according to any one of claims 34 to 61 wherein the composition is formulated as a one-part composition.
- 30 63. A composition according to any one of claims 34 to 61 wherein the composition is formulated as a two-part composition.

64. A composition according to claim 63 wherein a first part of the composition comprises:

- (i) a (meth)acrylate functional monomer,
- (ii) a (meth)acrylate functional oligomer,
- 5 (iii) a photoinitiator,
- (iv) a thickener, and
- (v) an amine, and
- (vi) optionally, an acrylamide,

and optionally additionally one or both of:

- 10 (i) a plasticiser
- (ii) a pigment component.

65. A composition according to claim 64 wherein a second part of the composition comprises encapsulated epoxy resin.

66. The cure product of a composition according to any one of claims 34 to 65.

15 67. An assembly component having applied thereto a composition according to any one of claims 34 to 66.

68. A threaded assembly component for example a bolt having applied thereto a composition according to any one of claims 34 to 65.

68. Reciprocally threaded articles having their respective threads bonded together by  
20 the cure product of a composition according to any one of claims 34 to 64.